

lowed by the publication of his *Philosophy of Storms*, Boston, Mass., 1842, after which he was appointed meteorologist to the United States Government and was assigned to duty, first in the War Department, afterward to the Navy Department, and eventually under the Smithsonian Institution. In 1836 he organized a joint committee of the American Philosophical Society and the Franklin Institute for the purpose of studying storms. This work was continued when he removed to Washington, D. C. Observations were gathered and numerous maps constructed, and extensive selections from these were published in his four successive reports, 1845-1860. While Espy dwelt especially on the mechanical theory of the development of storms, Redfield devoted himself to the collection of data illustrating the phenomena, and especially the general movement, of storm centers over the ocean. The general tendency of these two investigators was to establish the fact that individual features of the weather, as well as the storms, as a whole, move over the globe in such a manner that their arrival at any place can be predicted if we have at hand a series of maps showing their movement during the preceding few days. The spread of the electric telegraph throughout the United States during the years preceding 1848 suggested the possibility of compiling such weather maps regularly every day, and the first one was made, as a sample, for Prof. Joseph Henry, by Mr. J. J. Jones, of New York, in that year; but it was not until the next year that Professor Henry obtained from the telegraph companies a general concession for the free use of the telegraph lines for scientific purposes. Daily maps were made, for personal study, from that time forward for several years, and a large wall map, showing the condition of the weather day by day, began to be publicly displayed in the Smithsonian building from 1856 onward. This map was made the basis of frequent special predictions of the weather for the benefit of members of Congress and others who consulted Professor Henry. The success of these predictions furnished a strong argument for the establishment of a general weather service by the Government; but this was not effected until the demand for it came, not from the scientific meteorologists, but from the business interests of the country. In 1868 the Director of the Cincinnati Observatory was, at his own suggestion, authorized by the Cincinnati Chamber of Commerce to organize, at its expense and for the benefit of the merchants of that city, a system of daily weather reports and predictions. After this was done and in successful operation, the work was brought to the attention of the National Board of Trade, meeting at Richmond, Va., in November, 1869, and that body favorably indorsed a general memorial to Congress on behalf of all the commercial interests of the country. This memorial was prepared by Prof. I. A. Lapham and H. E. Payne, both of Milwaukee, Wis. The resulting joint resolution and the act signed by the President February 9, 1870, authorized the Secretary of War to establish a system of telegrams and reports for the benefit of commerce. This military service was transferred to the Department of Agriculture in July, 1891, and its duties were extended so as to include agriculture and all other interests affected by the weather.

When we compare among themselves the daily weather maps showing actual observations carefully made all over the country and presenting, as it were, a photograph of the atmospheric conditions twice or three times a day, one must be impressed with the fact that the predictions of the weather published by the Weather Bureau are based upon a solid foundation of facts and that its methods are radically opposed to those of the local weather prophets and the astrologers.

THE DRIFT OF THE GULF STREAM NEAR KEY WEST, FLA.

The Weather Bureau observer at Key West, Fla., Mr. W.

U. Simons, communicates to the Chief of the Weather Bureau a card found in a well-sealed bottle in shallow water, half a mile east of Saddle Bunch Channel and about 12 miles north of east from Key West, about noon May 31. This card contained a notice to the effect that the bottle was deposited in the sea on April 18, in latitude $24^{\circ} 18' N.$ and longitude $84^{\circ} 25' W.$ The point of deposit was therefore about 150 miles distant, and west-southwest of Key West.

In accordance with the general policy of the Weather Bureau, the card picked up by our observer has been forwarded to the Hydrographic Office, United States Navy.

ECLIPSE SHADOW BANDS AND CORRELATED ATMOSPHERIC PHENOMENA.

The following note was prepared by the Editor for publication in 1887, and may still be of interest:

Meteorology has perhaps not much to expect from observations of the barometer and the wind during a total solar eclipse, but it has considerable interest in the shadow bands. It seems quite plausible that the explanation of these is to be found in the interference of two pencils of sunlight that have respectively passed through adjacent portions of air of slightly different densities. This should not be called a diffraction phenomenon, though it does occur when a thin sheet of light from the edge of the sun passes the edge of the moon at the moment preceding totality. Undoubtedly such a slender beam of light may cause diffraction phenomena, but if so, the diffraction bands would necessarily move onward over the earth's surface with the same relative speed as that of the moon and the earth, namely, approximately a mile a second, whereas the observed shadow bands have a velocity of only a few feet or yards per second. On the other hand, the bands may be considered as phenomena of interference of rays of light slightly inclined by reason of the irregular refractions in a nonhomogeneous atmosphere, and they must therefore have such characteristics as are impressed upon them by the condition of the atmosphere at the time; their horizontal movement must correspond nearly with that of the winds and upper currents in the atmosphere. In fact, we need not necessarily speak even of interference phenomena. Every small mass of descending dense air constitutes a rough sort of lens or prism, the beam of light that passes through it must be deflected and the atmospheric mass casts a shadow on the ground, like a lens or prism of glass. Such phenomena may be seen when the air is very much disturbed even in ordinary full sunlight but become much better defined when the sun's disk is reduced to a slender crescent, as during the few seconds preceding and following totality. If there be no small masses of rising hot and descending cold air, but if we conceive the layers of the atmosphere to have definite horizontal surfaces thrown into waves, then the refraction of the light as it passes through these waves would certainly produce beams of light having slight inclinations to each other, which would produce shadows and interferences when they intersect. All interference phenomena in sunshine under favorable circumstances give rise to bands of color rather than alternate bands of darkness and brightness. We are, therefore, inclined to speak of the shadow bands as really shadows produced by the irregular refractions of the atmosphere rather than as pure interference phenomena, although they may partake of the character of both, but they certainly have not the characteristics of diffraction bands, properly so called. Similar shadows contribute materially to the rather complex phenomena of twinkling or scintillation. When a very bright star is observed near the horizon, it not only flickers as to color and brightness, but actually disappears momentarily, due to the fact that its light is refracted so far away from the eye that none of it enters the pupil. The shadow bands